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Trip experience report

People visited

During this trip, from June 1 to July 19, 2014, I visited the Wisconsin Astrobiology Research Consortium (WARC) at the Department of Geoscience at the University of Wisconsin – Madison. This group focuses on the detection and interpretation of organic signatures of life in modern and ancient environments on Earth and other planetary bodies, in addition to inorganic signatures of life, which may have the greatest fidelity over billion-year timescales and complex geologic histories. Among the team members of WARC, I worked directly with Prof. John Valley, an expert on zircon geochemistry at the University of Wisconsin – Madison, and team member Prof. Aaron Cavosie, an expert on detrital shocked minerals at the University of Puerto Rico – Mayagüez. Under the supervision of both Prof. John Valley and Prof. Aaron Cavosie, I was able to use the facilities and the necessary instruments at UW – Madison in order to conduct sample preparation and analysis for my MS thesis. In addition, I worked with the laboratory technicians Mike Spicuzza and Brian Hess. Mike Spicuzza helped me use multiple laboratory facilities, and Brian Hess not only made my thin sections, but taught me some of the steps for thin section preparation.

Techniques learned

In order to conduct this research, the samples of sand were previously sieved to sizes > 500 µm at the University of Puerto Rico – Mayagüez. At the University of Wisconsin – Madison, sample preparation included heavy mineral separation using instruments such as the gold table. The heavy mineral concentrations were then separated into different splits by their magnetic properties using a Frantz magnetic separator. After the samples were magnetically separated, further heavy mineral separation was conducted using the heavy liquid acetylene tetrabromide, in order to obtain a heavy mineral concentration. From this heavy mineral concentration, zircon and apatite grains were picked under a binocular microscope and placed onto a scanning electron microscope (SEM) stub with carbon tape, and later carbon coated in order to prepare them for secondary electron (SE) and backscatter electron (BSE) imaging using a Hitachi S-3400N SEM. Additional techniques included cutting rocks into slabs and billets using multiple rock saws, and casting the rock slabs and billets into epoxy for thin section preparation.

Problems

During the trip, no problems were encountered with the facilities in the Department of Geoscience at UW – Madison. The faculty members were very polite and

tried to help in any way that they could. The instruments used did not have any major problems, and research could be conducted very efficiently. During the last week of the trip, I injured my knee and was admitted to a hospital for 72 hours. The problem affected my work schedule, but it was not a life threatening situation.

Preliminary results

In this study, we documented new occurrences of detrital shocked minerals in regional drainages located around the Santa Fe impact structure. This discovery expanded the distribution of shocked bedrock in the region, beyond where shatter cone outcrops had been previously reported. Detrital shocked minerals documented in this study include both shocked zircon (Fig. 1) and apatite (Fig. 2) derived from sediments (colluvium and alluvium) collected from drainages in all directions away from the known shatter cone outcrops in the Santa Fe impact structure region (NM Hwy 475). A total of 1612 zircon grains were surveyed from 6 samples of colluvium and alluvium, which yielded 4 confirmed shocked grains (4/1612 = 0.25%). A total of 792 apatite grains were surveyed, yielding 26 confirmed shocked grains (26/792 = 3.3%). These results extend the occurrences of shocked minerals beyond the known shatter cone localities, which may indicate that previous estimates of the impact structure's size are too small. This documentation of new occurrences of detrital shocked minerals and rocks may indicate a larger original crater diameter.

Figures

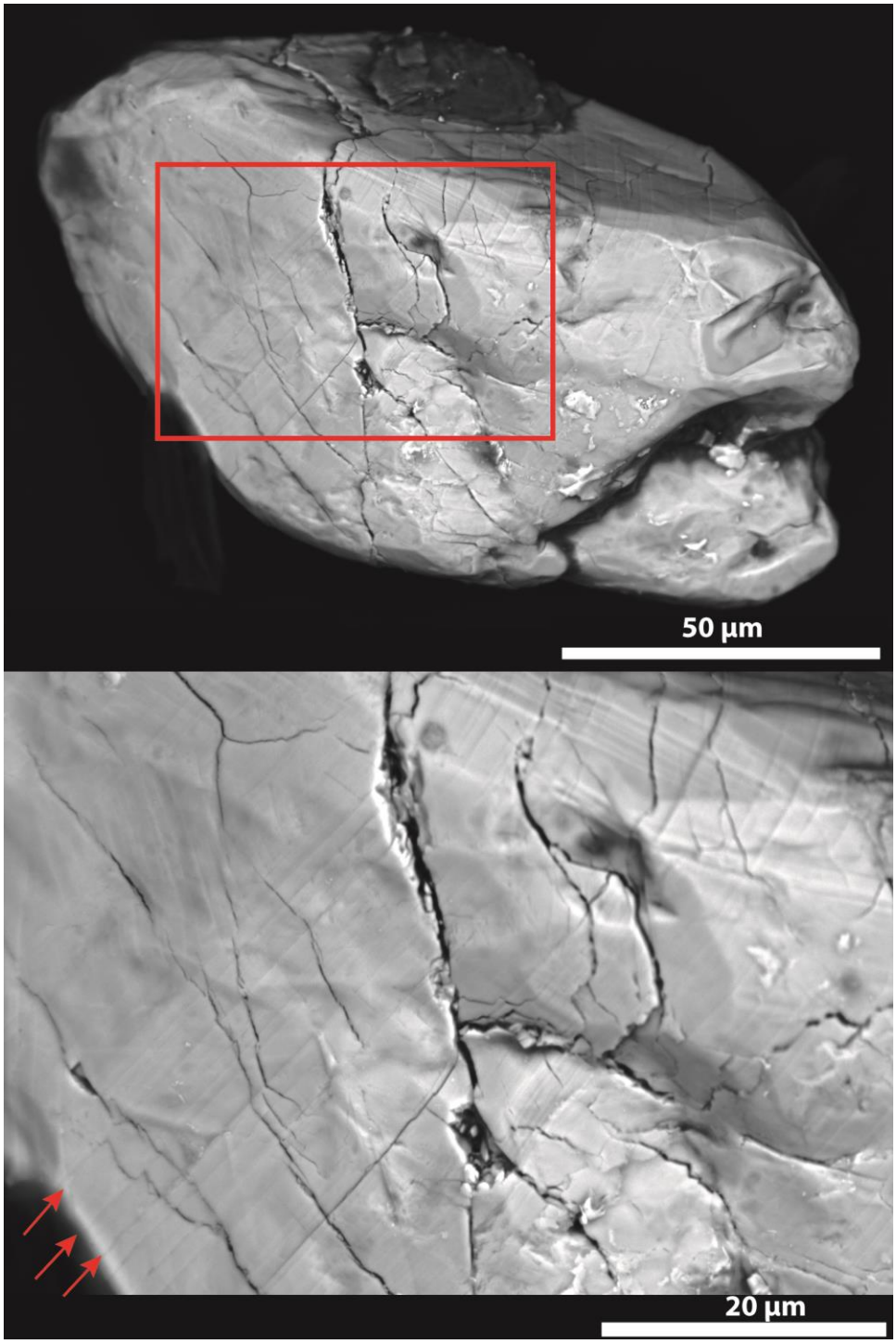

Figure 1: Backscatter electron (BSE) image of detrital shocked zircon grain from the Santa Fe impact structure. Arrows indicate one set of planar fractures (PFs).

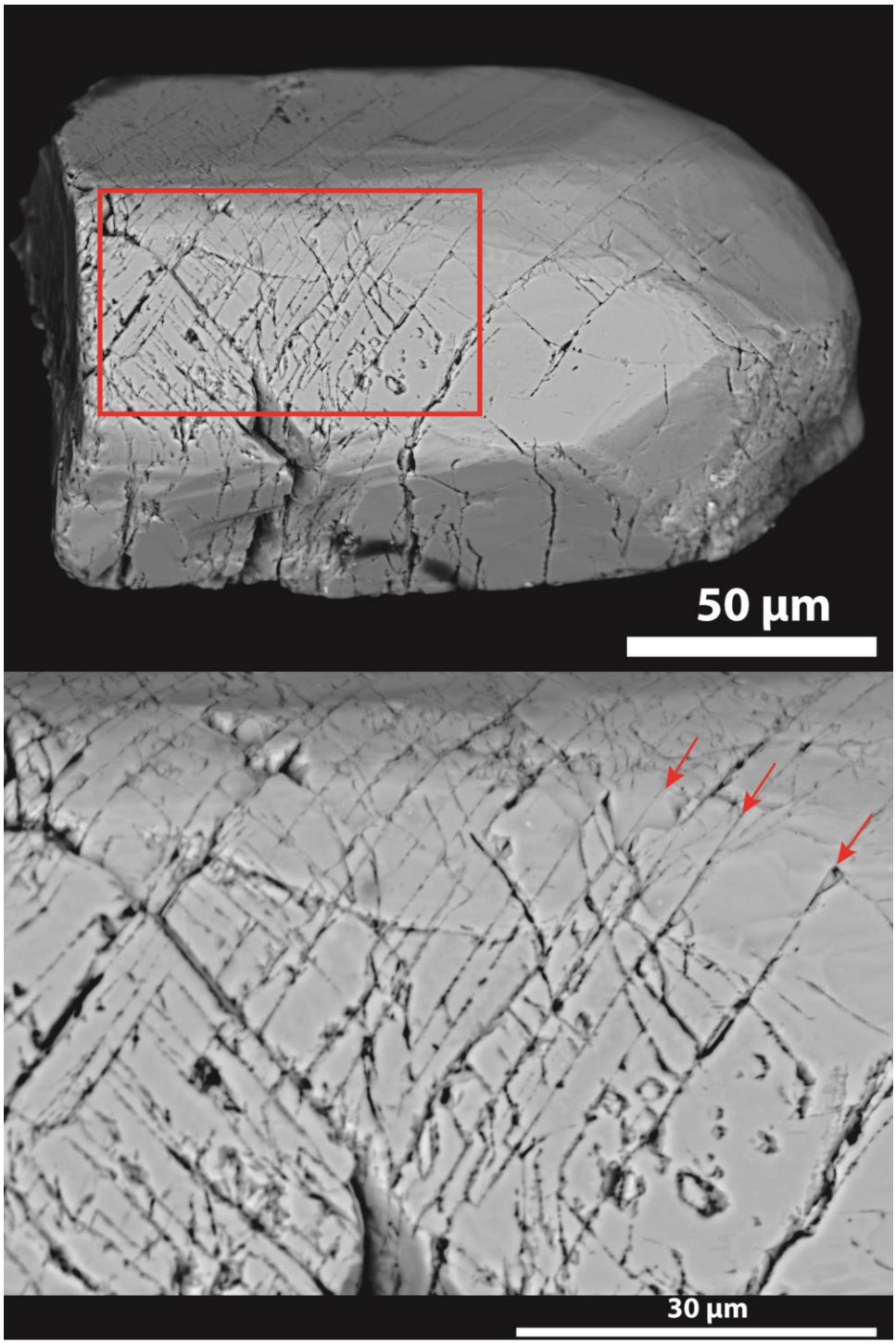

Figure 2: Backscatter electron (BSE) image of detrital shocked apatite derived from the Santa Fe impact structure. Arrows indicate one set of planar fractures (PFs).

Additional images

Image 1: University of Puerto Rico – Mayaguez (UPRM) group working with the scanning electron microscope (SEM) at UW – Madison.

Image 2: Grain picking from a sample. After grain picking, samples are carbon coated and surveyed using a scanning electron microscope (SEM).

Image 3: Preparing to mount a sample in the scanning electron microscope (SEM).